3.0 AFFECTED ENVIRONMENT

3.1 GEOLOGY AND SOILS

3.1.1 Geology

Orange County includes a diverse combination of mountains, hills, flatlands, and shoreline. These landforms and associated major canyons, ridgelines, and coastal areas all contribute to the diversity of Orange County's environment.

Orange County is located within the southern Los Angeles Basin. The Los Angeles Basin is within the northern Peninsular Ranges Geomorphic Province, which terminates at the Transverse Ranges Geomorphic Province to the north and trends to the tip of Baja Mexico.

The Peninsular Ranges Province is broken up into structural blocks that are bound by active faults: the Newport-Inglewood, Whittier-Elsinore, San Jacinto, and the Banning fault zone. The Palos Verdes fault zone off-shore and the San Andreas fault zone to the east, are other known large fault features near or within the Peninsular Ranges Province (Greenwood et al., 1991).

The backbone of Orange County geology is the Santa Ana Mountain Range, which extends from the Puente Hills near Prado Dam southeast beyond the county limits. The Santa Ana River is primarily responsible for the surface geology of the study area. The river, which drains the San Bernardino Mountains, flowed across the land's surface in its present position before the Santa Ana Mountains were elevated. The persistent river has cut a channel, eroding the steep narrows now known as the Santa Ana Canyon. The river has deposited great quantities of alluvial material on the land that is now Orange County, providing the basis for an excellent soil for our agricultural industries. The heavily populated, areas of the county are built upon this ancient floodplain (Irvine Valley College, 2000).

3.1.2 Seismicity

Orange County has a relatively low number of known faults as compared to most other counties in Southern California. However, like most regions that border the Pacific Ocean, Orange County is subject to a high level of seismic activity, with potentially destructive earthquakes. Six major active or potentially active fault zones are known within or near the project area (OCEMA, 1987). Figure 3.1-1 shows the locations of major known faults near or within the SR-22/West Orange County Connection study area.

A. LOS ALAMITOS FAULT

The Los Alamitos fault is a short northwest-trending fault, which begins near Lakewood and travels parallel to the coast for approximately eleven kilometers (seven miles) into Los Alamitos. This fault is closest to the project area's western end and may even lie beneath portions of the I-605, I-405, and SR-22. The exact age and type of the fault is unknown. There has been no historic evidence (after 1769) of a surface rupture (SCEDC, 2000).

B. NEWPORT-INGLEWOOD FAULT

The Newport-Inglewood fault begins from offshore near Dana Point and comes inland at Newport Beach. From Newport Beach, the fault runs parallel with the coast through the communities of Seal Beach, Long Beach, and Torrance, then terminates in Los Angeles County (OCEMA, 1987). This fault is nearest to the project area's west end, roughly five kilometers (three miles) from the SR-22/I-405 interchange (SCEDC, 2000). The Newport-Inglewood fault generally runs through the Hellman Ranch property and the Seal Beach Naval Weapons Station.

Figure 3.1-1

In 1933, the Newport-Inglewood fault produced the Long Beach earthquake (magnitude 6.3, Richter scale), with its epicenter located off-shore. Although no onshore surface fault rupture has taken place in historic time, the fault zone should still be considered capable of surface rupture. The Seal Beach section of the Newport-Inglewood fault is considered potentially active and is included in the Earthquake Fault Zones established under the Alquist-Priolo Earthquake Fault Zoning Act (California PRC, Chapter 7.8). This act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults, which are the most easily avoided seismic hazard. This act addresses the dangers of an existing or potential surface fault rupture and is not directed toward other seismic hazards, such as liquefaction and seismically induced landslides. The Alquist-Priolo Earthquake Fault Zoning Act was a direct result of the 1971 San Fernando Earthquake.

C. WHITTIER FAULT

The Whittier fault zone is located approximately halfway between the San Andreas fault and the Pacific Ocean shore. This fault is believed to be the main spur from the larger Elsinore fault, which follows a trend easterly of the Santa Ana Mountains from Mexico. The Whittier fault is approximately 40 kilometers (25 miles) long, approximately 20 kilometers (12.5 miles) from SR-22, and shows Holocene activity through offset stratigraphy. This fault is believed to be the origin of the 1987 Whittier-Narrows earthquake, which registered a magnitude of 5.9 on the Richter scale. Known data indicates that the Whittier fault zone is capable of generating an earthquake of magnitude 7.5 on the Richter scale, accompanied by surface ruptures (SCEDC, 2000).

D. SAN ANDREAS FAULT

The San Andreas fault is an active strike-slip fault that follows a northwest trend through San Bernardino County and into Los Angeles County to the north. This fault is located approximately 85 kilometers (53 miles) east of the SR-22/West Orange County Connection project. In 1857, the San Andreas fault produced an earthquake of magnitude greater than 8.0 on the Richter scale. The San Andreas fault is expected to generate strong earthquakes (8.0 or higher), and to have an average peak ground acceleration under a g force of 0.4 (or 0.4 g) in the study area (SCEDC, 2000). (1.0 g is a gravitational force of a body at sea level.)

E. EL MODENO FAULT

The El Modeno fault is located east of the study area within the Peralta Hills area of Orange County. The El Modeno fault is a southwest-dipping, north/south trending, normal fault that extends from the Peralta Hills area south into Santiago Creek in the Peters Canyon Wash, approximately 6.5 kilometers (four miles) northeast of the SR-22. This fault may be capable of an earthquake of magnitude 6.0 on the Richter scale (SCEDC, 2000).

F. PERALTA HILLS FAULT

The Peralta Hills fault is an approximately east/west trending, north-dipping, thrust fault that is located west of the SR-55 and approximately five kilometers (three miles) north of the SR-22. It is believed that this fault has ruptured the ground surface in Holocene period, and may be capable of generating an earthquake of a magnitude in the range of 6.0 to 7.0 on the Richter scale. This fault is not included under the Alquist-Priolo Special Studies Zone Act (SCEDC, 2000).

3.1.3 Soils

There are two large soil associations in the SR-22/West Orange Connection study area:

- Hueneme-Bolsa
- Metz-San Emigdio

These soil associations comprise about 39 percent of all soil types in Orange County (USDA, 1978).

A. HUENEME-BOLSA ASSOCIATION

This association is located mainly on floodplains. It extends from Seal Beach southeast to the Santa Ana River and about 16 to 19 kilometers (10 to 12 miles) inland from the coast, making up about 11 percent of Orange County. The soils are formed in very deep alluvium and have slopes ranging from zero to two percent. Plant cover for this association is comprised of annual grasses, forbs, mustard, and plants that require moisture. This association is commonly used for truck crops, field crops, and urban development. Elevations range from 1.5 to 107 meters (5 to 350 feet) (USDA, 1978).

B. METZ-SAN EMIGDIO ASSOCIATION

The Metz-San Emigdio association is located primarily on the upper floodplains from the Santa Ana Canyon area west to Buena Park and Stanton, and southwest to Garden Grove and the northern part of Santa Ana. Smaller areas also occur on the floodplains near Tustin southeast of Borrego Canyon. The soils are formed in very deep alluvium. Slopes can range from zero to nine percent. The plant cover is usually annual grasses and forbs. This association is used for straw berries, citrus, row crops, field crops, and urban development. Elevations range from 3 to 460 meters (10 to 1,500 feet) (USDA, 1978).

3.1.4 Liquefaction

Liquefaction is the transformation of soils from a solid state to a liquid state due to increased water pressures. When a saturated sandy or silty soil is subjected to seismic shaking, water pressure of the soil can increase enough to liquefy the soil, causing it to loose bearing strength. Alluvial soils are generally sandy throughout the project area, and liquefaction is possible where these soils are saturated. The saturated condition generally occurs where the water table is less than 15 meters (50 feet) below the ground surface, or when rainfall is heavy. Areas of highest potential for shallow groundwater typically correspond to the historic lowlands or to drainage areas of surface waters and swamps. For the most part, the SR-22 West/Orange Connection Project study area has a high water table and is located in a region that has moderate to high susceptibility to liquefaction (USGS, *Seismic Liquefaction,* 2000). See Figure 3.1-2 for areas susceptible to liquefaction.

3.1.5 Expansive Soils

Expansive soils have grains that swell and increase in volume when water is added. This triggers cracking, slipping, or sinking of residences, sidewalks, and swimming pools. Much of Orange County suffers from this problem because of the clay structure of the soil (Orange County, August 1987).

3.1.6 Landslide, Erosion, Subsidence, and Uplift

Landslides result from the movement of slope-forming earth or rock materials downward under the influence of gravity. A landslide may take the form of a flow, slide, fall, or a combination of the three. This form of earth movement is the most costly of the non-seismic geologic hazards. The study area is located on a generally flat terrace, therefore, there is a low potential for landsliding to occur.

Erosion is the process by which rock and earth are either worn away or transported, usually by water, wind, or ice. The minor slopes in the SR-22/West Orange County Connection project study area are generally landscaped, preventing excessive erosion.

Subsidence and uplift are caused by forces within the earth's crust or by withdrawal or injection of fluids or solids such as oil, water, soil, or rock. The proposed project study area has a very low potential for subsidence or uplift (Orange County, 1987).

FIGURE 3.1-2
LIQUEFACTION

3.1.7 Seiches and Tsunamis

A seiche is the oscillation of sloshing of water caused by seismic activity of landsliding in a lake, bay, or other enclosed body of water. There are no large bodies of water present in the vicinity of the proposed project study area. Small ponds and reservoirs are present on golf courses and parks, but they do not present a potential for seiches due to their low volume of water.

Tsunamis are waves that travel in the open ocean, and are caused by an undersea earthquake, landslide or volcanic activity. As tsunamis approach the shore, the ocean bottom becomes more shallow and the energy carried by the wave is funneled into the shallower water, causing the wave heights to increase. The Orange County coastline is shielded to the west by the Channel Islands and to the north by Point Conception from most sources of tsunamis, thereby reducing the threat of damage (Orange County, August 1987).

3.1.8 Mineral Resources

There is currently no economic mineral resource extraction in operation within the study area; therefore, there is a low potential of mineral loss due to the construction of the proposed project.

3.1.9 Paleontological Resources

Soils in and around the study area are dominantly from sedimentary rock sources. Although fossils are most typically recovered from sedimentary rocks, the sedimentary rock in the study area is a result of alluvial deposits; i.e., it was carried to the area by streams. Alluvial deposits have a low potential for paleontological resources. The project study area is also not classified by the *Orange County General Plan* as an area of high paleontological sensitivity (Orange County, August 1987). [1]

[1] The general plan is available at OCTA.

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